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ABSTRACT

This study is an exploratory analysis of class-level data concerning junior high school (JHS) students' affective and motivational beliefs. It examines class-level information on selected psychological characteristics that students, who read at the fifth-grade level, bring to learning mathematics and that teachers encounter during instruction. Focus is on the variability among 60 classes on 7 affective and motivational indicators and determining whether teachers encounter different psychological characteristics of a class across classes of different mathematical achievement levels and in the same class across different activity settings. Study data are from the fall 1988 administration of the Mathematics Assessment Questionnaire (MAQ) to 1,737 students in 7th- through 9th-grade mathematics classes at 8 junior and senior public high schools in New York City. Students' responses to four affective beliefs (value, interest, confidence, and anxiety), two motivations (internal learning goals and external performance goals), and one attribution (unknown control) are examined. Differences among classes and among activity settings are found. This study highlights to the wide differences among mathematics classrooms in the psychological environment for learners and teachers, and provides an exploratory analysis of differences that may characterize urban mathematics classrooms on several important belief areas related to mathematics learning. Included are 1 table, 12 bar graphs, and an illustration of study calculations. (RLC)

Affective and Motivational Characteristics of 60 urban JHS math classrooms: A class-level analysis of student beliefs in three instructional activity settings

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CASE 06 - 92

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Affective and Motivational Characteristics of 60 urban JHS math classrooms: A class-level analysis of student beliefs in three instructional activity settings

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Graduate Center, City University of NY

This paper describes an exploratory analysis of class-level data concerning JHS students' affective and motivational beliefs. This work draws on research which has examined factors related to student mathematical learning and on classroom studies of activity settings used in instruction. Research related to school learning, and mathematics in particular, has identified constructs such as anxiety, confidence, value, interest, motivations and attributions as related to student achievement and persistence (Fennema & Sherman, 1977; Chipman, Brush & Wilson, 1985). The emphasis on activity settings used in instruction is based on the work of Stodolsky (1988) and Brophy & Alleman (1991). These studies and analyses find an activity framework meaningful to students and teachers when they characterize classrooms in different subject matters.

In this paper we examine a set of class-level information on selected psychological characteristics which students bring to learning mathematics and which teachers therefore encounter during instruction. We examine this information from a particular perspective. This perspective focuses attention on one of the levels of analysis which teachers could encounter and find useful during instructional planning within their own classes. Specifically, we describe the variability among 60 classes on seven affective and motivational indicators. We then examine whether teachers will encounter different "psychological characteristics of a class" in two situations: 1) across classes of different mathematical achievement levels; and 2) in the same class across different activity settings.

The data presented here were collected as part of a larger study of students' beliefs about learning and doing mathematical word problems. In this larger study we developed the Mathematics Assessment Questionnaire, A survey of thoughts and feelings, (MAQ) for students in grades 7-9. Although the objective of the MAQ is to provide teachers with information about the affective and motivational beliefs of students within their own class, we have found it informative to examine data on the class level. In this paper we take a step toward examining affective and motivational beliefs as class-level characteristics using an assessment tool which is intended for teacher use. The analyses described here are descriptive and examine

particular aspects of the psychological characteristics of mathematics classes which JHS teachers and students encounter as the environment for teaching and learning. To the extent that there is variability among classes in these psychological characteristics, the study can suggest the importance of using class-level analyses and the need to examine their implications for both learners and teachers.

The Mathematics Assessment Questionnaire

The data described here were obtained from an administration of the Mathematics Assessment Questionnaire, A survey of thoughts and feelings (MAQ) for students in grades 7-9. The MAQ is a Likert-type paper and pencil measure. It was developed to provide systematic observations of students' beliefs about doing and learning mathematics word problems in three classroom activity settings:

1. During Class, when the teacher is working with the whole class;
2. With Others, when a student is working in a small group with other students; and
3. Homework, when students are working in an independent setting.

In this study we examine student responses to four affective beliefs--Value, Interest, Confidence and Anxiety, to two motivations--Internal Learning Goals and External Performance Goals, and to one attribution--Unknown Control. This assessment tool uses three-item clusters to assess each affective, motivational and attributional belief within each activity setting. Since the MAQ is intended for use by teachers at the classroom-level, there are no normative data about students. The MAQ is intended for use by teachers in their instructional planning.

The CRT-type NEED indicators

A criterion-referenced (CRT-type) score is calculated for each three item cluster (e.g., Anxiety in During Class). These scores identify students whose responses indicate a possible need for follow-up instruction. The criterion is that at least two of the three statements are responded to in a way to indicate a possible need for follow-up in that area (marked at the extremes of the scale, e.g., indicating anxiety about working word problems in a group with other students).

The data analyses for this paper were based on a "score" for each class on each construct. The score was the percentage of students in the class indicating a need for teacher follow-up study, that is, the percentage of students who met the CRT-type score indicating need. Thus, each of

the 60 classes has scores on seven "beliefs" in each activity setting, where the scores are a percentage that can range from 0 to 99.

Sample

The MAQ was administered to 1737 students in mathematics classes at eight junior and senior public high schools in a major urban city (New York City) during the fall of 1988. The criteria for selecting students and classes were that students read at the fifth-grade level. The sample for this study includes 60 classes (1694 students): 21 grade 7; 19 grade 8; and 20 grade 9. Students attended seven schools, with between five and 13 classes included from any one school. Since student and item-level analyses indicated no differences between grades, summary data are for all 60 classes. The ethnic composition of the sample is approximately 23% Black, 22% Hispanic, and 44% white, with 56% females and 44% males. The average national percentile for the students on the Mathematics test of the Metropolitan Achievement Test was 69.2 (SD = 16.7).

Results and Discussion

In this exploratory study we examine the data in two ways: 1. Descriptive statistics are summarized over the 60 classes for the percentage of students within a class whose CRT-type scores indicate a possible need for follow-up; and 2. Selected classes are examined by means of graphs for the percentage of students whose CRT-type scores suggest need for follow-up.

Descriptive data for 60 Classes

Table 1 is based on the percentage of students in a class whose CRT-type indicators suggests a possible need for follow-up work in the various affective and motivational beliefs. Table 1 shows wide ranges among classes and across settings as indicated by the means and standard deviations. The minimum and maximum percentages of students also indicate differences among classes.

Across all three settings, the lowest mean need (CRT-type score) within classes is found for Confidence. For example, on average, only 7.71 percent of the students in any class responded in a way to suggest the need for follow-up work in Confidence During Class. That is, about 8% of the students reported low Confidence on two or three of the three Confidence statements in the During Class setting. These small percentages may reflect a general reluctance among students during the middle school years to admit a lack of confidence. Interestingly, as Table 1 indicates, larger percentages of students were willing to endorse Anxiety statements.

The motivation indicator External Performance Goals, varies the most across settings. In the During Class setting, an average of 41% of the students in each class reported perceptions of their motivations (External Performance Goals) that suggested the need for teacher follow-up. In the Working With Others setting an average of 18% of the students indicated a need for follow-up work, while an average of 41% indicated a need in the Homework setting. External performance goals address students' perceived reasons or motivations for why they work problems. A need suggests that students perceive that they do word problems for external reasons -- for the teacher, to get a better grade, for extra credit. A "need" means that students responded to at least two of the three statements in a way indicating their perceptions of external motivations.

Graphs of affective and motivational characteristics of selected classes

We examined graphs which depicted the percentages of students within a class whose CRT-type scores suggested the need for follow-up instructional work. Sample graphs are presented in Figures 1 - 12. We use the graphs to explore two questions: 1. Are classes at about the same achievement level similar in terms of students' affective and motivational beliefs?; and 2. Do class express different affective and motivational perceptions depending upon the activity setting that they are asked about?

Examples of differences among classes with similar math achievement scores

Four classes were randomly selected to represent each of three math achievement levels represented in this sample: High, Average and Low Math Scorers. The math achievement indicator was the percentage of students within a class whose national percentile on the Mathematics Test of the Metropolitan Achievement Test was below the 50 percentile. We chose this criterion as a general indicator of the classes "achievement climate." The classes were selected as follows:

High Math Scorers: NO students scored below the 50th percentile. The mean MAT national percentiles for the students ranged from 90 to 93.

Average Math Scorers: Approximately 1/4 of the class scored below the 50th percentile (24-26% of the class). The mean MAT national percentiles for the students ranged from 57 to 65.

Low Math Scorers: More than 60% of the students scored

below the 50th percentile. The mean MAT national percentiles for the students ranged from 36 to 50.

Within each achievement level, we randomly selected four classes to graph, including one class at each grade level 7, 8 and 9, and at most two classes from the same school. The same classes are represented in the same order for each setting in the graphs.

Figures 1-3 graphically present the percentage of students whose CRT-type scores suggest the need for follow-up for High Math Scores in the During Class, With Others and Homework settings respectively. Figures 4-6 present similar information for Average Math Scorers on the Mathematics Test of the Metropolitan Achievement Test. Finally, Figures 7-9 present graphs for the Low Math Scorers. Examination of the graphs suggests that there are differences among classes within the same achievement range as defined here, as well as differences between achievement levels. Furthermore, differences were not always in the directions expected. As an example of differences among classes at the same achievement level see Figure 1, High Math Scorers During Class. One class reports a high number of students with CRT-type scores suggesting the need for follow-up work in the area of Interest, about 50%, while another class reports relatively low perceived need (about 10%).

Examples of differences within classes across different activity settings

Figures 10-12 depict the percentage of students within a class whose responses indicate a possible need for follow-up in each activity setting. These graphs are for high, average and low math scorer classes. That is, a single class was selected and the percentage of students whose CRT-type scores indicate the need for follow-up instruction were graphed for the During Class, With Others and Homework settings.

Examination of these graphs suggests there are differences among settings and among classes. For some classes, the percent of students whose responses suggest the need follow-up for a construct is fairly consistent, regardless of the activity setting. For example, in Figure 12, about 25% of the students indicate a CRT-type need for Interest across the During Class, With Others and Homework settings. Thus, the need for follow-up regarding students perceived lack of interest is a characteristic for about one-quarter of the class in each activity setting. Contrast this with Figure 11, an Average Math Scorer class. Over 60% of the students reported a perceived lack of Interest (need) in Homework (i.e., low interest in working math problems for homework is reported on at least two of the three statements). However, only 20% of the students

report low interest in the group problem solving setting while approximately 40% report low interest in the During Class setting. In Figure 10, differences are also evident on Interest across settings.

In general, for the class depicted in Figure 12, large differences in perceived need are not evident across the three activity settings. However, in Figures 10 and 11 differences are suggested. The classes presented in Figures 10, 11 and 12 are for illustrative purposes only. Other class characteristics would have been evident had we selected different examples. The point is that classes differ on affective and motivational beliefs according to activity setting, and these differences do not appear dependent on the achievement level of the class.

Conclusions and Implications

Based upon the exploratory descriptive analyses of the class-level MAQ data, we found differences among classes and among activity settings. We choose to examine the data descriptively and graphically for several reasons. First, we wanted to get a "feel" for these data. We do plan to examine the variance attributed to individuals and classrooms using a hierachical linear model approach. Second, the pscyhometric properties of the CRT-type approach used to calculate the need indicators and to convey information to teachers in the affective and motivational areas has not been thoroughly investigated. Third, the MAQ was developed for classroom use by teachers and not developed to provide scaled scores for individual students (only three items are used to assess a psychological construct within any settings). The main concern of all our work with the MAQ has been to provide teachers with information they can use and interpret.

We have already seen implications in providing this type of information to teachers. Interviews with teachers indicate differences in the types and levels of information teachers want about their students, particularly when discussing the affective and motivational domains. We have found that some teachers are most interested in learning how individual students think and feel. Often they remark about some aspect of the student's behavior -- "the student is doing well, but very quiet" or "this student is struggling, but I'm not sure why." Such teachers tend to be less interested in examining class level responses. There are however, many teachers who are more interested in examining data for a class, rather than looking at responses of individual students. They want to "get a sense" of their classes' affective and motivational beliefs. These teachers then plan instructional activities based upon the overall characteristics of the class.

Educational and Scientific Importance

The educational importance of this study is in drawing attention to the wide differences among mathematics classrooms in the psychological environment for learners and teachers. The scientific importance of the study lies in providing an exploratory study of the differences that may characterize urban math classrooms on several important belief areas related to math learning. Important areas for research are the relationship of student beliefs to those of teachers, and the long-range relationships to achievement and further course taking in mathematics.

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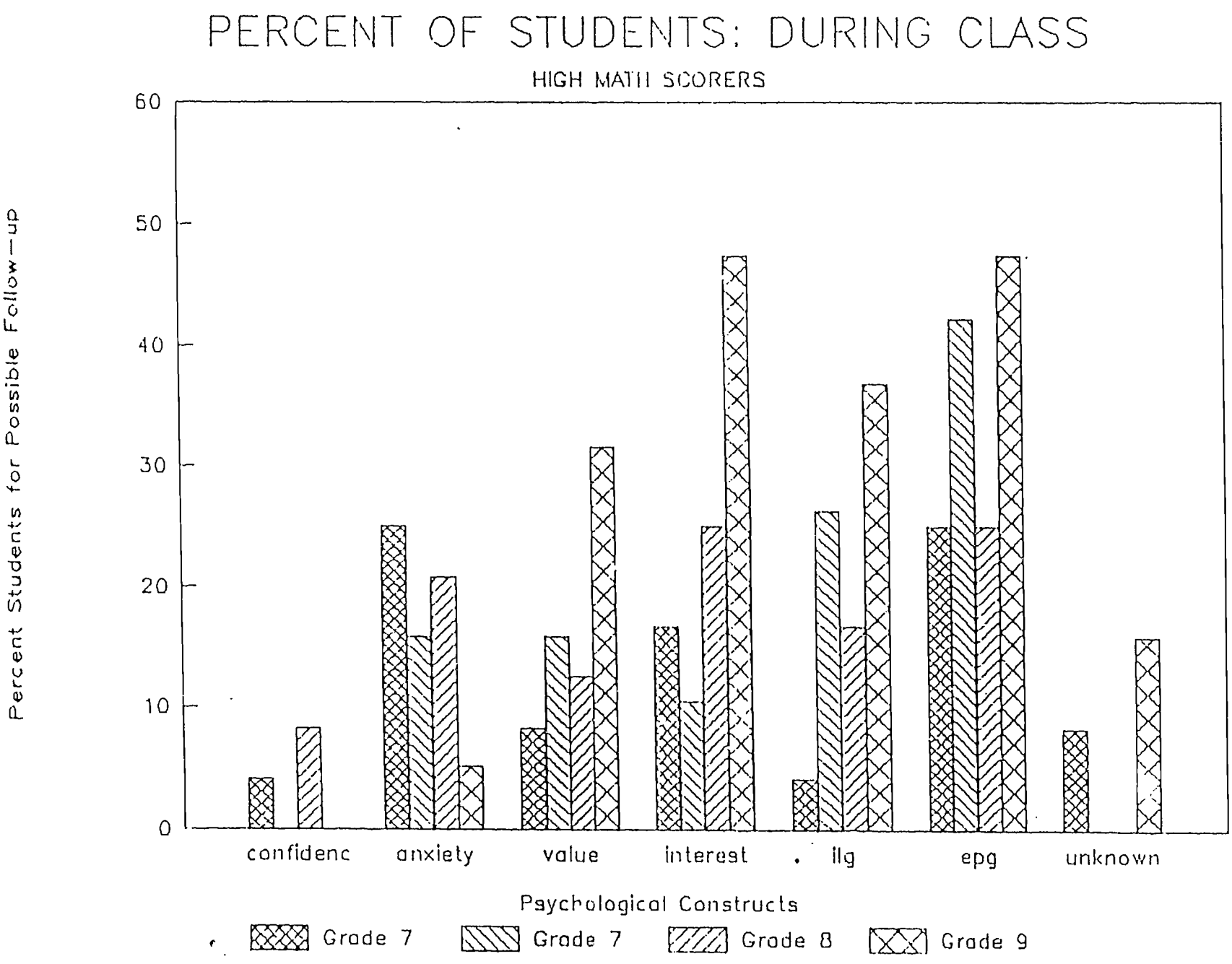
Table 1

Percent of Students Within 60 Classes Whose Responses Indicate a Possible Need for Follow-up on Affective and Motivational Beliefs

Activity Setting/ Belief	Mean	Standard Deviation	Minimum	Maximum
During Class				
Confidence	7.71	6.74	.00	29.17
Anxiety	20.37	10.92	.00	45.45
Value	12.51	9.02	.00	36.36
Interest	25.63	10.54	9.09	54.55
Internal Learning Goals	17.22	8.36	.00	40.74
External Performance Goals	41.02	13.53	11.54	73.91
Unknown Control	9.06	7.52	.00	29.17
With Others				
Confidence	8.22	5.94	.00	22.73
Anxiety	12.95	7.81	.00	37.50
Value	24.35	11.91	.00	55.26
Interest	17.41	8.82	.00	36.00
Internal Learning Goals	15.33	9.43	.00	42.11
External Performance Goals	18.15	11.57	3.45	52.63
Unknown Control	11.22	10.09	.00	50.00
Homework				
Confidence	8.62	6.58	.00	25.00
Anxiety	12.48	8.77	.00	31.82
Value	14.55	9.20	.00	37.50
Interest	39.06	12.91	13.33	79.17
Internal Learning Goals	21.41	10.84	4.55	46.15
External Performance Goals	40.67	11.10	11.76	62.50
Unknown Control	13.10	8.97	.00	42.11

Figure 1


PERCENT OF STUDENTS: DURING CLASS
HIGH MATH SCORERS
Percent Students for Possible Follow-up
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Psychological Constructs
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Grade 9

Figure 2

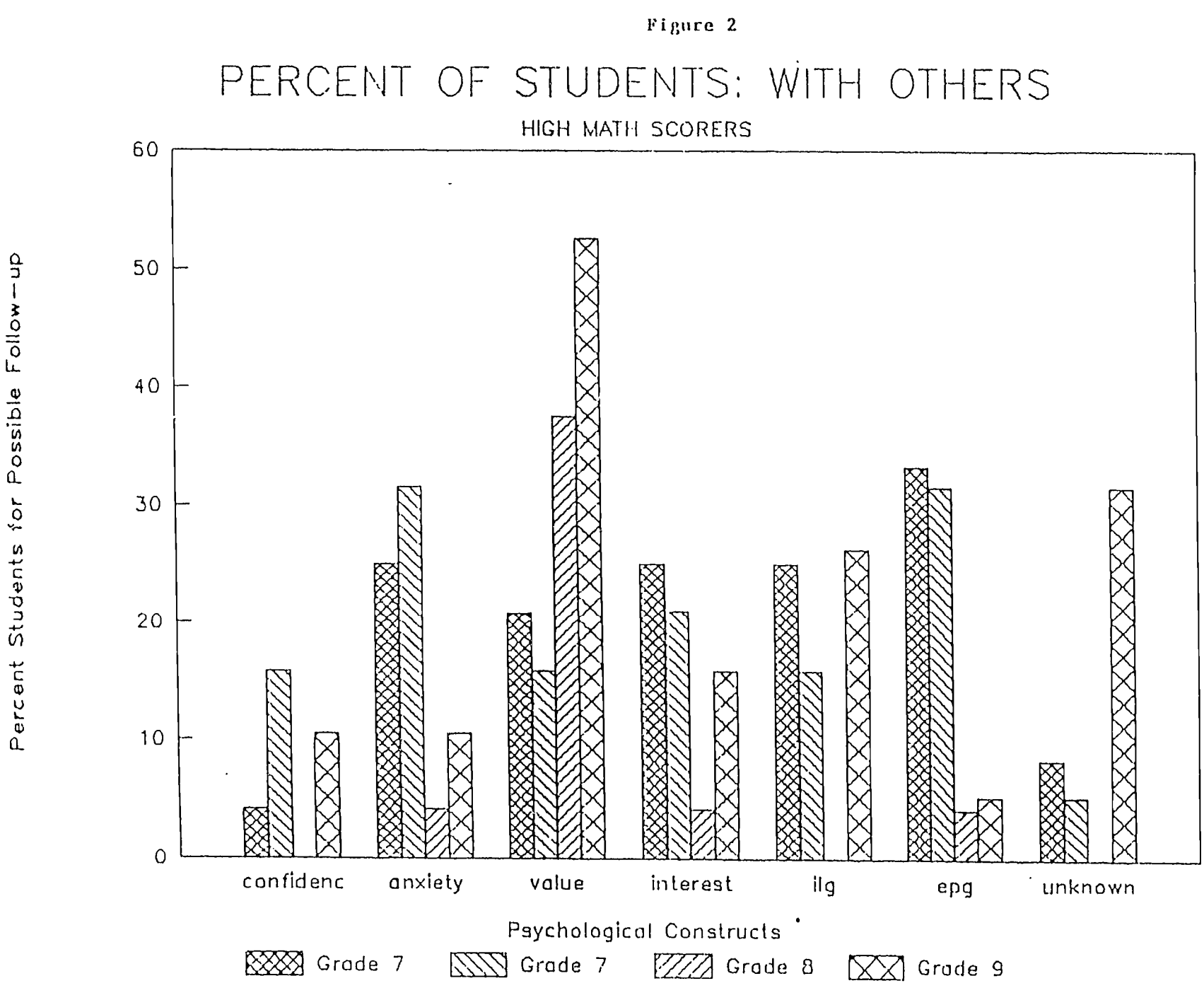
PERCENT OF STUDENTS: WITH OTHERS
HIGH MATH SCORERS
Percent Students for Possible Follow-up
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Figure 3

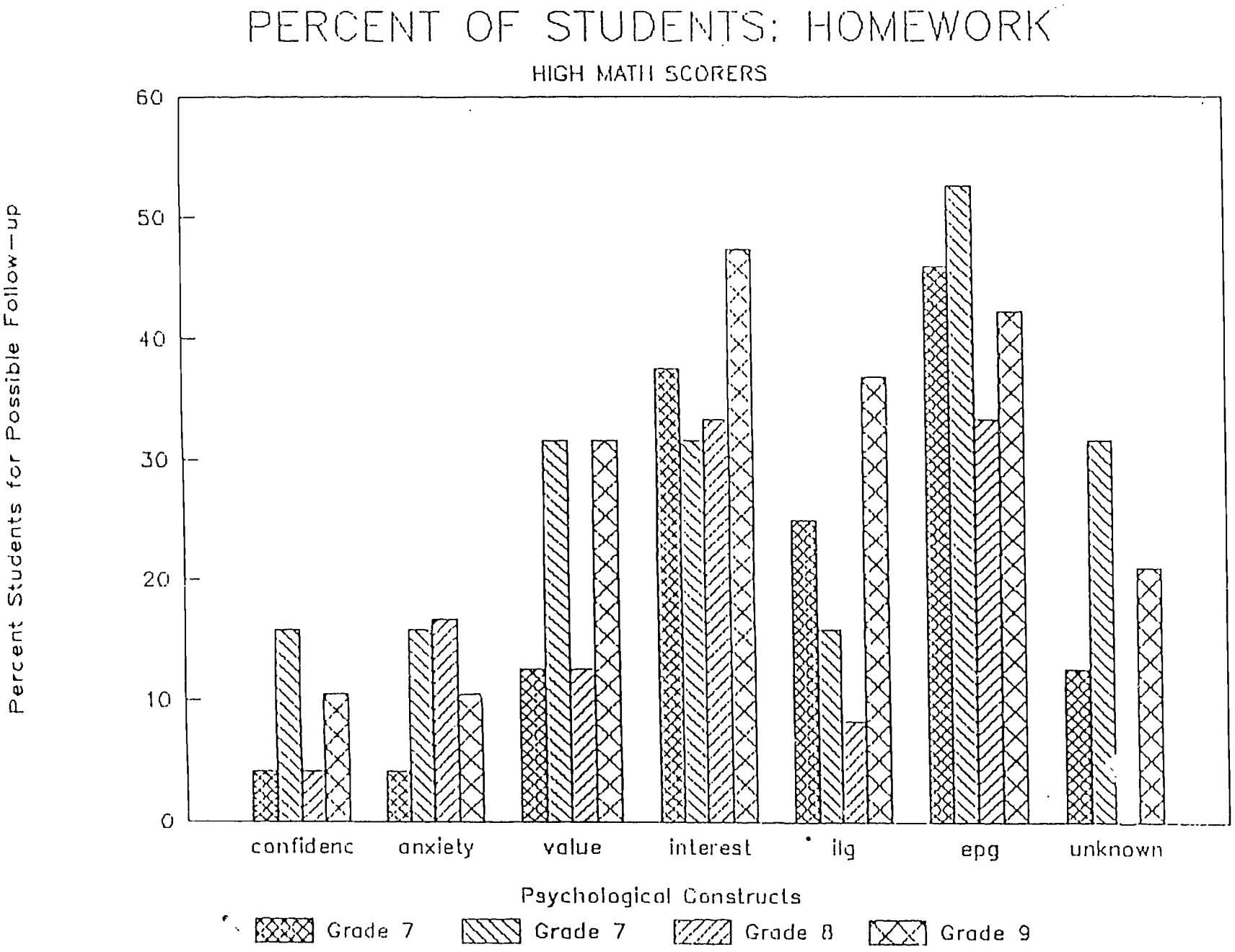
PERCENT OF STUDENTS: HOMEWORK
HIGH MATH SCORERS
Percent Students for Possible Follow-up
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Figure 4

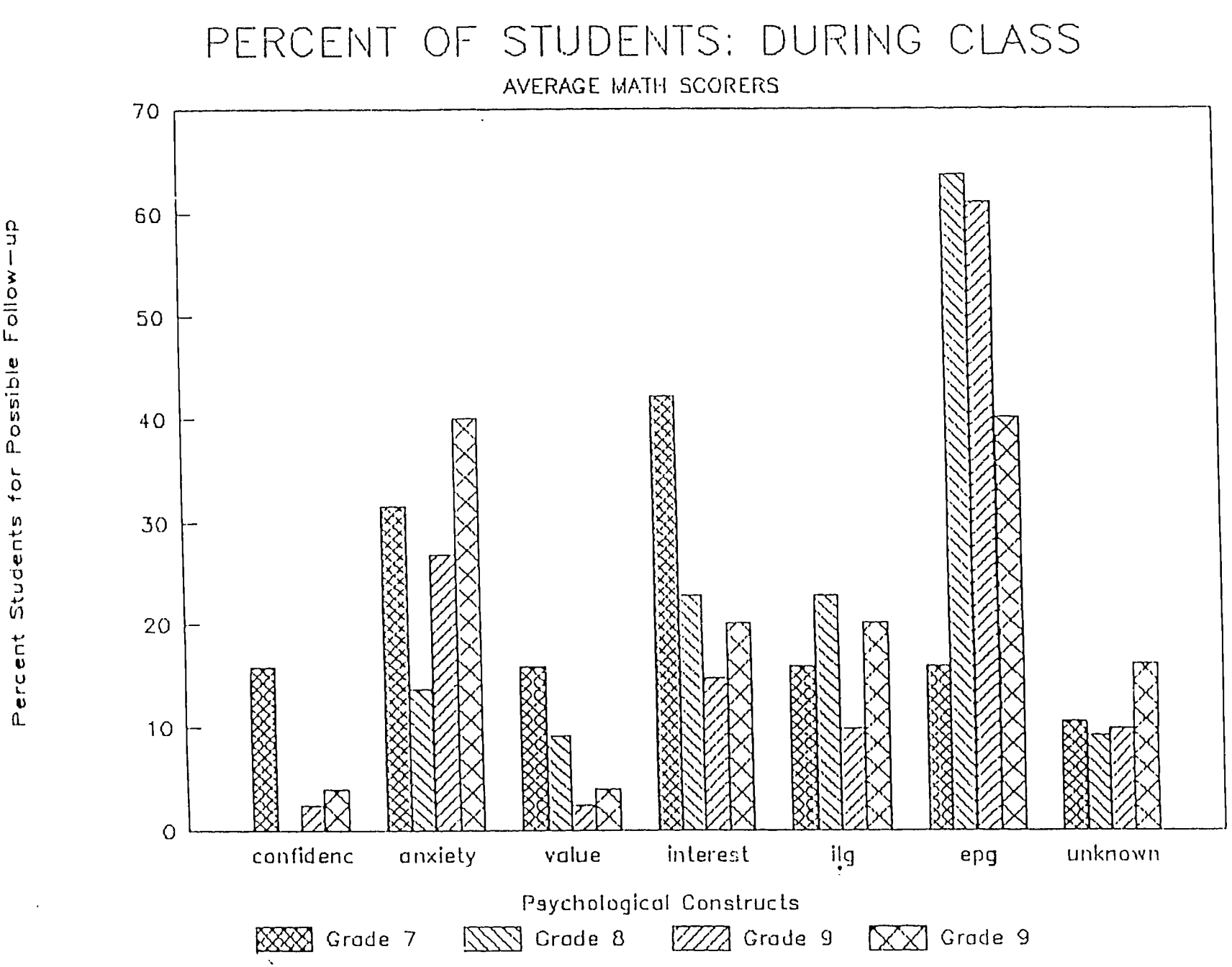
PERCENT OF STUDENTS: DURING CLASS
AVERAGE MATH SCORERS
Percent Students for Possible Follow-up
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Figure 5

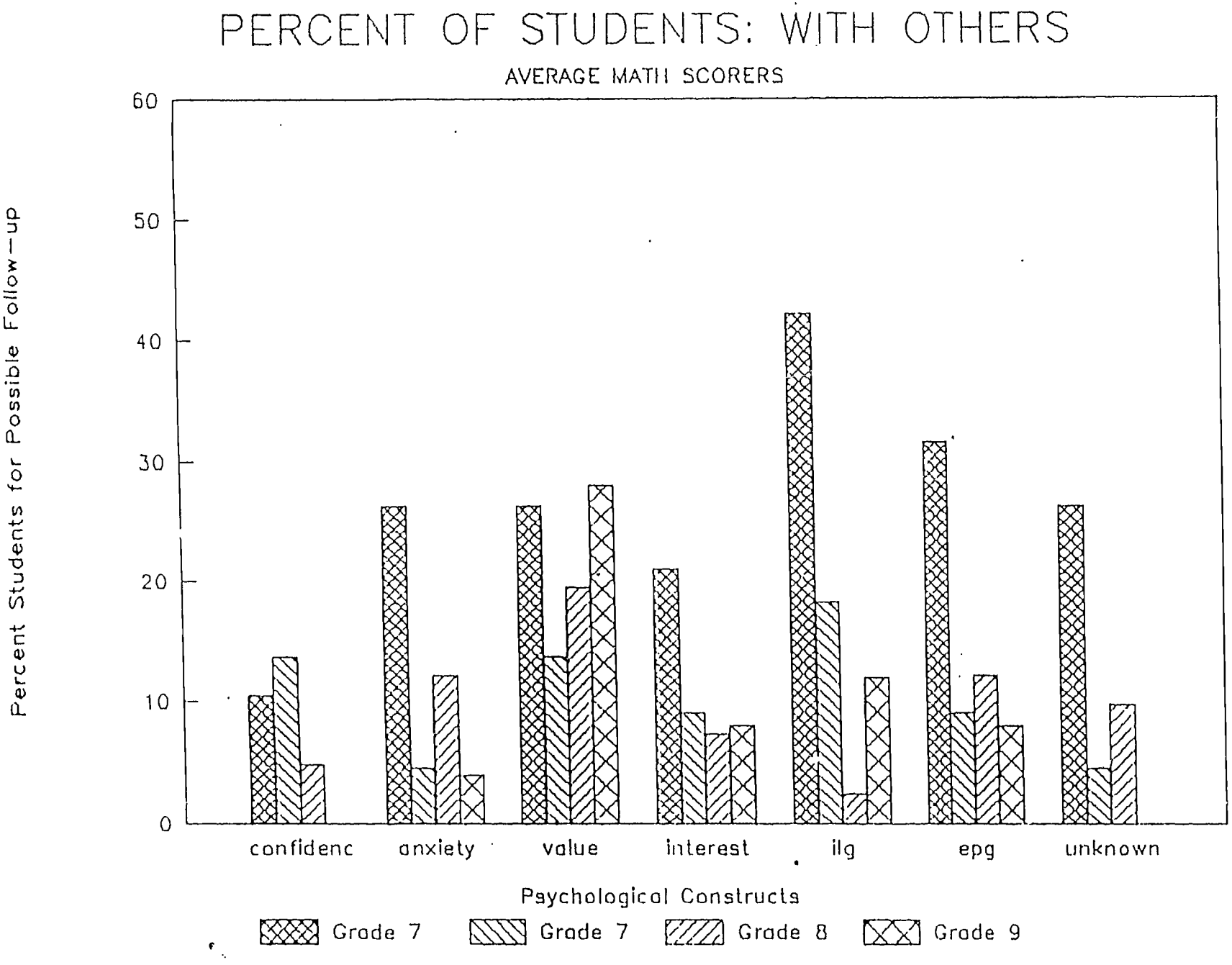
PERCENT OF STUDENTS: WITH OTHERS
AVERAGE MATH SCORERS
Percent Students for Possible Follow-up
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Figure 6

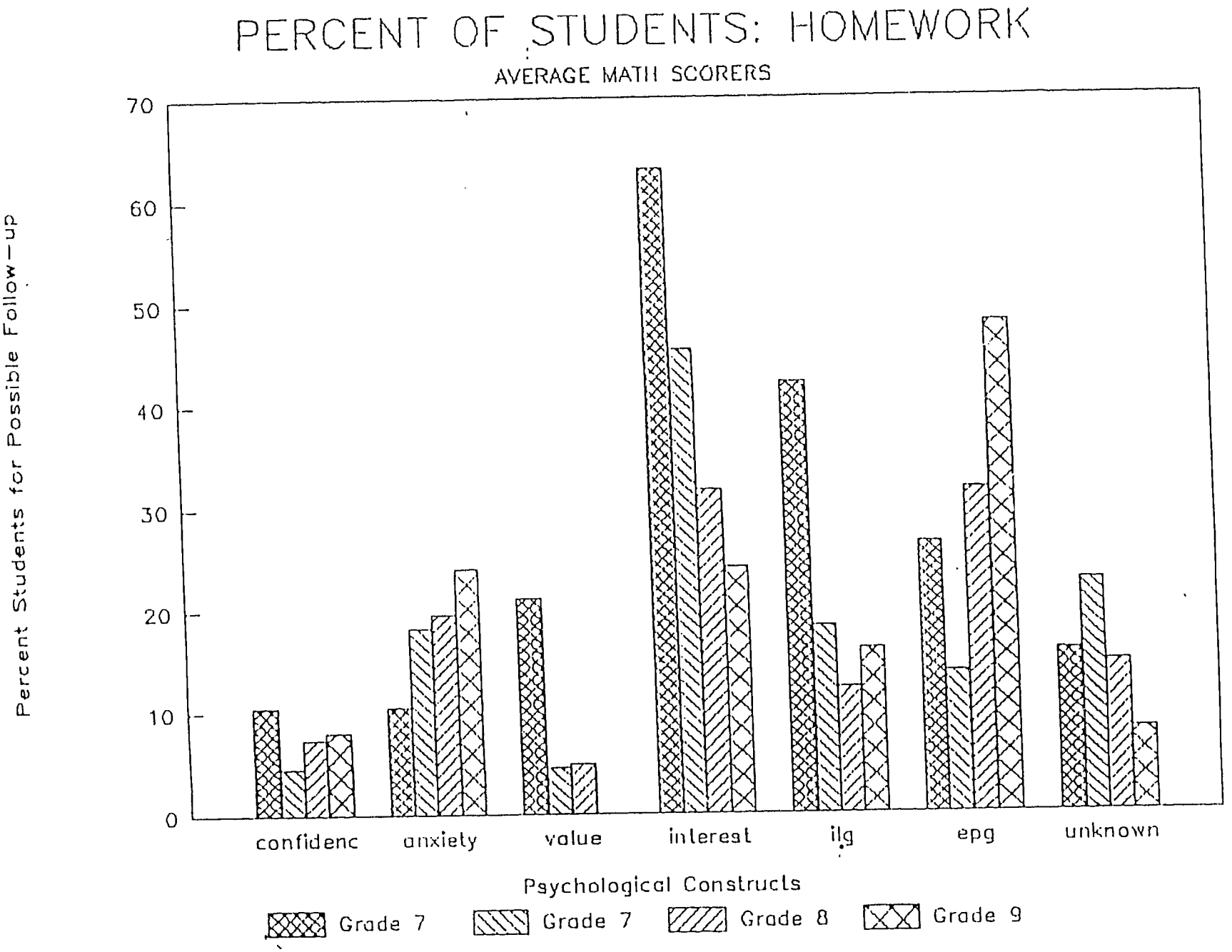
PERCENT OF STUDENTS: HOMEWORK
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Figure 7

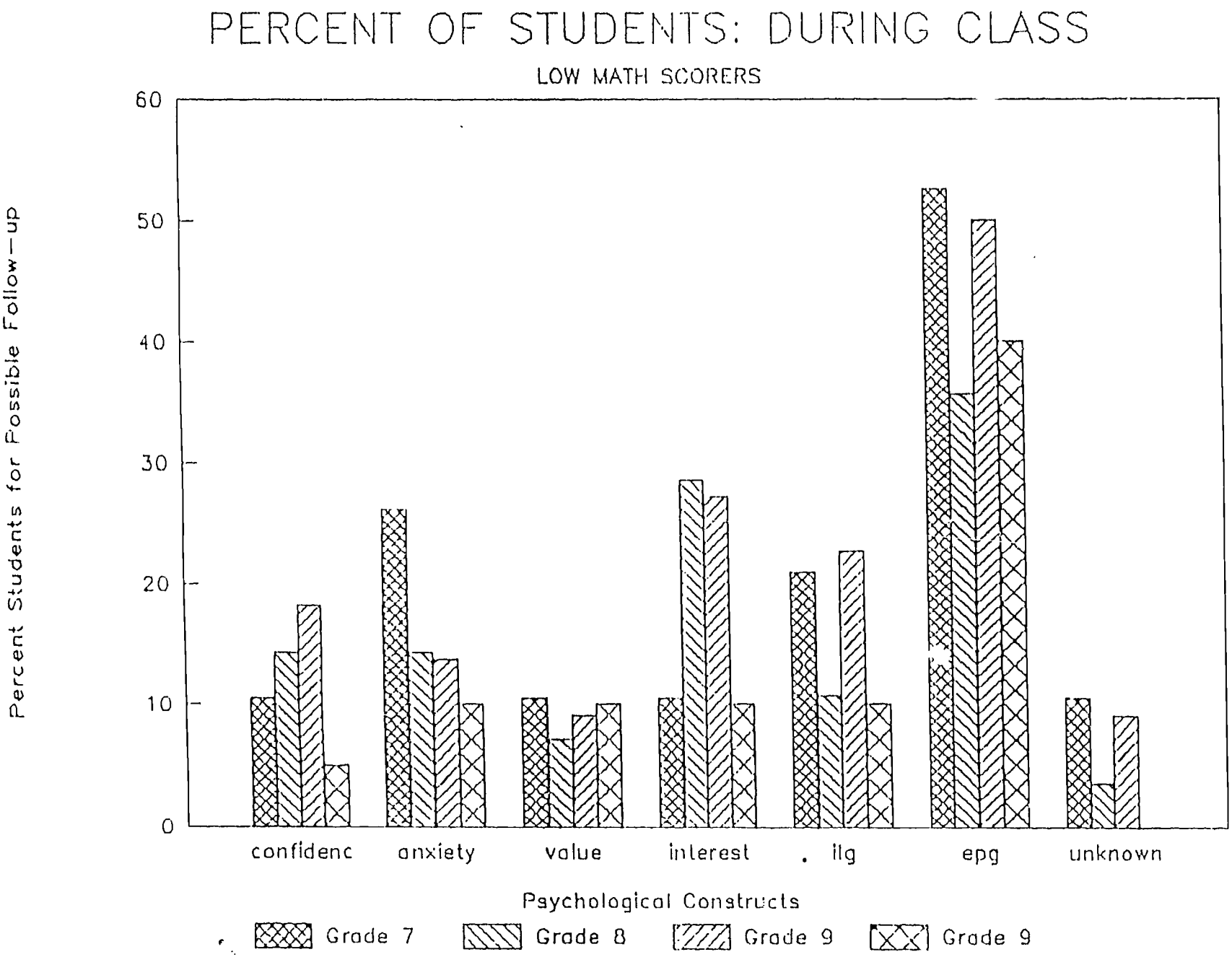
PERCENT OF STUDENTS: DURING CLASS
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Figure 8

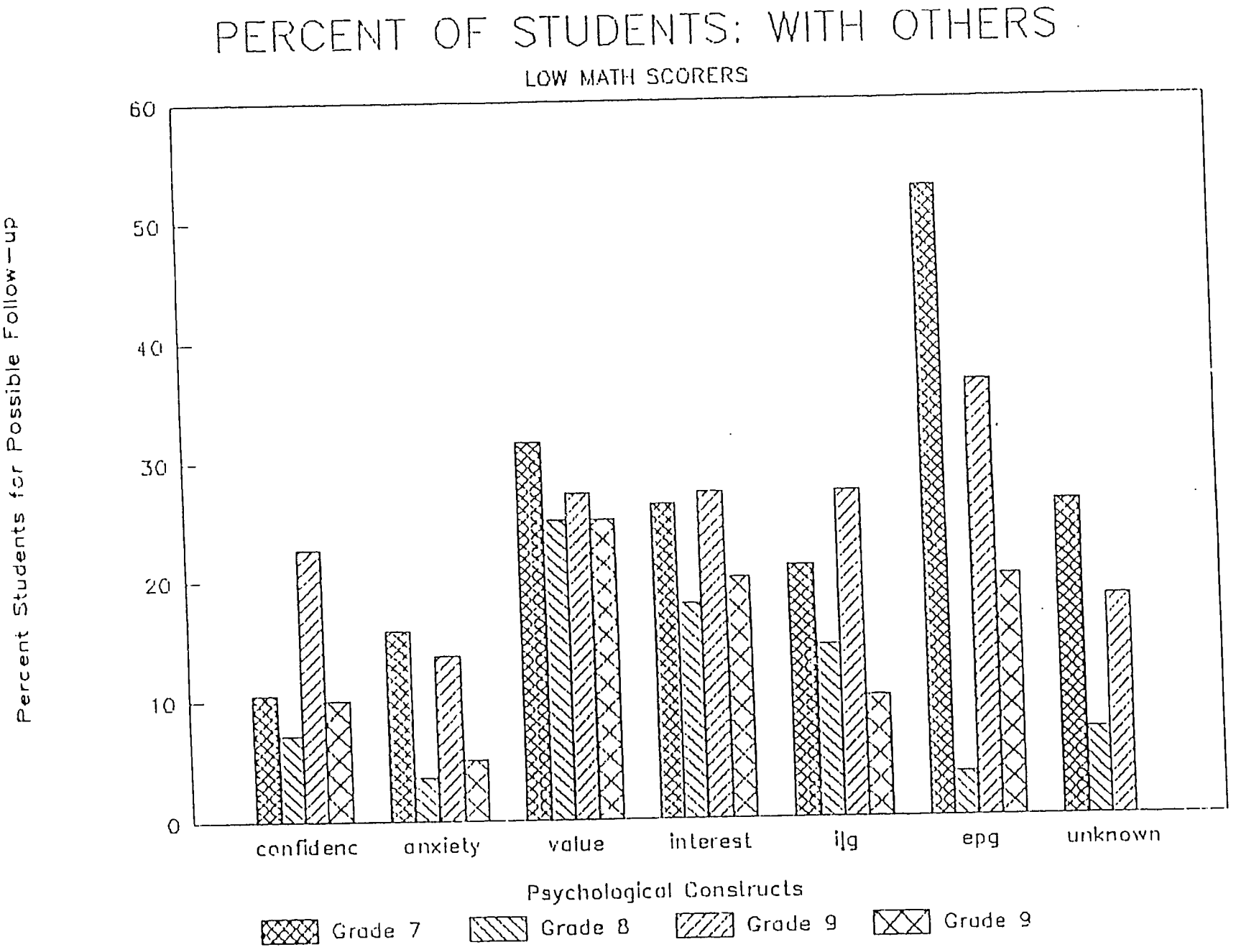
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Figure 9

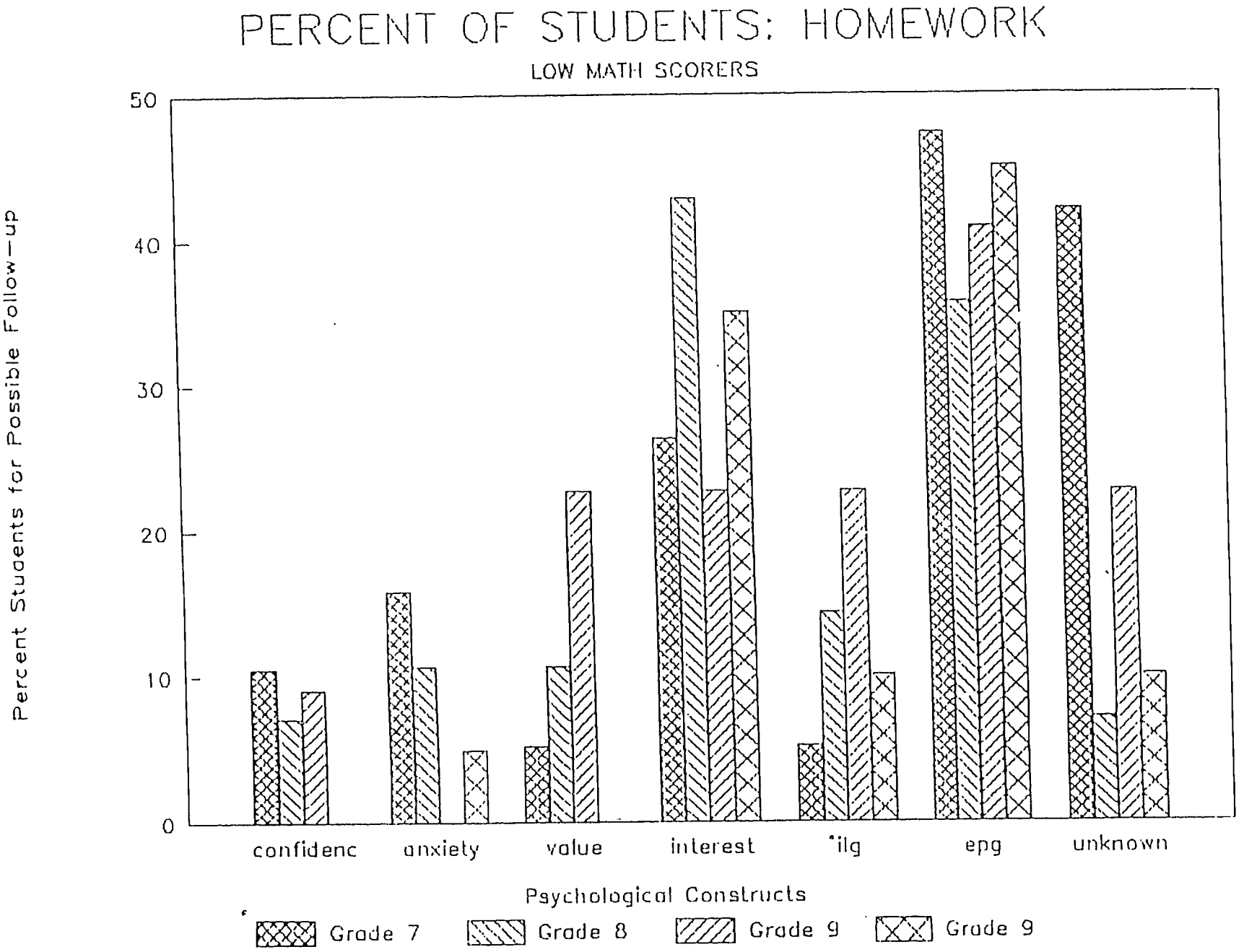
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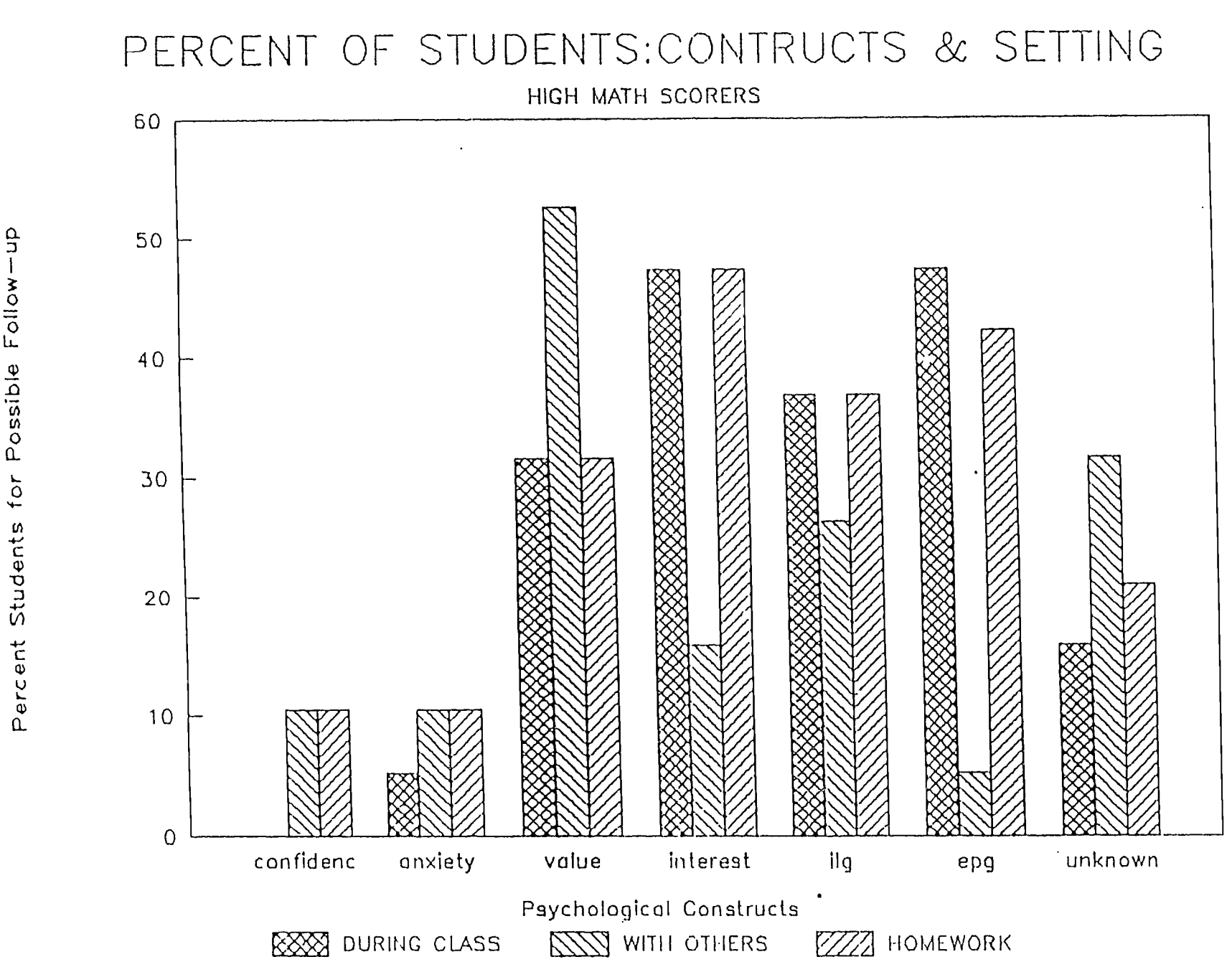
Figure 10


PERCENT OF STUDENTS:CONTRUCTS & SETTING
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DURING CLASS
WITH OTHERS
HOMEWORK

Figure 11

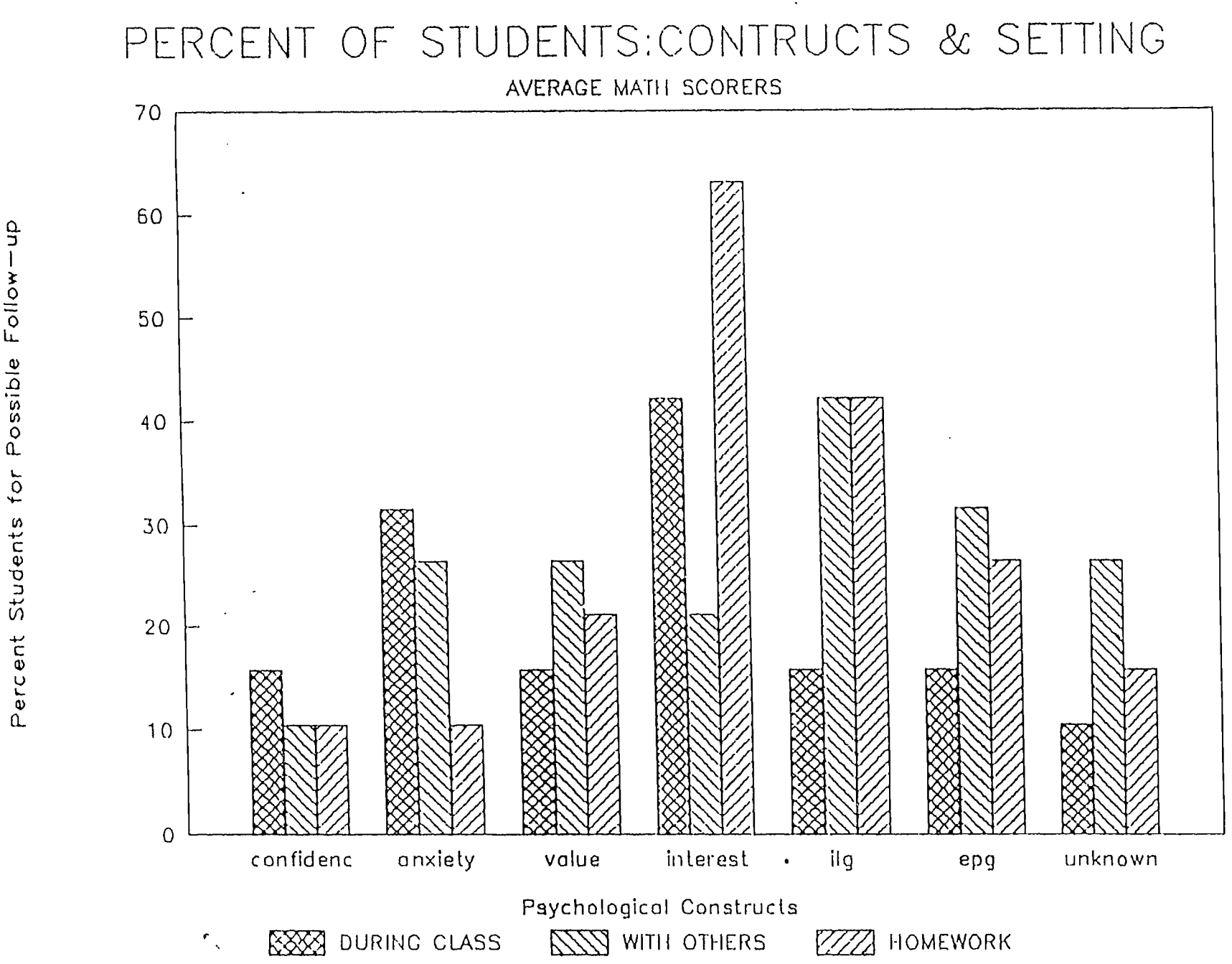
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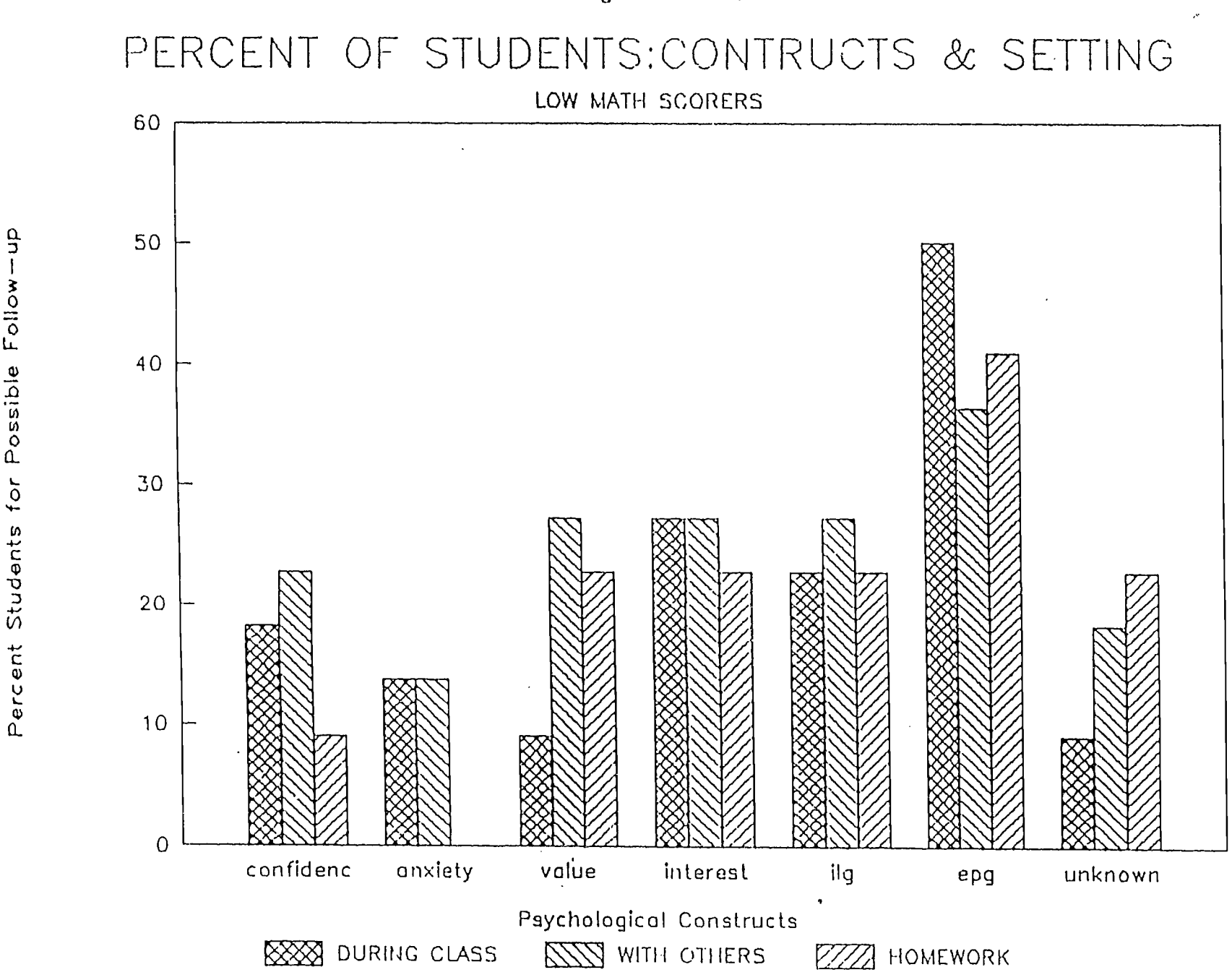
Figure 12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Psychological Constructs
DURING CLASS
WITH OTHERS
HOMEWORK

MATHEMATICS ASSESSMENT PROJECT
CALCULATION OF THE NEED INDICATORS

General Interpretation of NEED Indicators

	Need Indicators
Affective Beliefs:	
Value	low
Interest	low
Confidence	low
Anxiety	high
Motivational Beliefs (to learn/do):	
Internal Learning Goals	low
External Learning Goals	high
Attributional Beliefs (causes of success/failure):	
Unknown Control confused about causes	high

NEED is indicated when a student responds to AT LEAST TWO of the three statements in a way to suggest the need for follow-up (e.g., ANXIETY).

AN EXAMPLE OF THE CALCULATION OF A NEED INDICATOR: ANXIETY-HOMEWORK
(* is the student's response)

	VERY TRUE	TRUE	SORT OF TRUE	NOT VERY TRUE	NOT AT ALL TRUE
17. I feel nervous when I think about doing hard word problems for homework.	*				
23. I feel relaxed when I am doing math word problems at home.					*
31. Doing word problems for homework does not make me nervous.			*		

The student reports feeling anxious on two statements, indicated by a response in one of the two extreme categories--(Item 17, a VERY TRUE response; Item 23, a NOT AT ALL TRUE response); On Item 31 the student does not report feeling anxious.

NEED is indicated since the student responded to AT LEAST TWO of the statements in a way to suggest ANXIETY.